THE ANATOMY OF THE PREGNANT TUBE.

A Study in serial section, with a clinical analysis of 95 cases of Tubal Pregnancy.

Being a Thesis for the Degree of M.D.,
University of Edinburgh.

by

HENRY SPEIRS,

M.B., Ch.B.

April 1908.

THE ANATOMY OF THE PREGNANT TUBE

A Study in serial section, with a clinical analysis of 95 cases of Tubal Pregnancy.

INTRODUCTORY.

The present research was undertaken during my tenure of office as Resident Physician at the Chelsea Hospital for Women with a view to throwing some light on those features of Tubal Gestation which are still under discussion. Recent monographs on the subject such as those of Russell Andrews, of Berkeley and Bonney and others, are not in agreement for instance as to the extent to which the Pregnant Tube shows a decidual reaction. Some observers find only decidua-like cells scattered here and there in the connective tissue spaces, whilst others maintain that deciduation may proceed so far as to shew well developed compact and spongy layers. The great diversity in the results which have been obtained must lead one to ask whether or not it is a difference in the age of the gestation sac or whether the tube itself varies in the extent to which it reacts to the invading trophoblast, in various cases. An attempt will be made to deal with this problem.

Again, theories as to the Aetiology of Tubal Pregnancy are almost as numerous as the pathological conditions which have ever been discovered in relation with the tube. Inflammatory conditions chronic and acute, conditions of mal-development inherited or acquired have all at one time or other been cited as possible factors in the production of the disease while more recently attention has been turned to abnormalities in the ovum itself and those, together with all the possible aberrant routes from the Graaffian Follicle to the Uterus which the ovum may adopt, have been suggested as possibly causative. This is not to be wondered at, for the disease is met with under such diverse circumstances as would apparently baffle any attempt to discover a uniform pathological factor underlying such a chaos of clinical conditions. Tubal Pregnancy is met with in women at all stages of the child-bearing life, in the young primipara just entering the productive period, as well as in the aged multipara just completing that phase of her life. A tubal gestation may occur as a first pregnancy in an otherwise healthy woman, it may succeed a long period of primary or secondary sterility, or it may arrive with the eighteenth pregnancy following a long series of normal labours, (vide Case 87). The clinical picture is thus

extremely varied and unless the details are accurately filled in from the microscope, the result is valueless from an aetiological point of view. Only recently has the serial section method been adopted but with its advent the gaps in our knowledge of the rationale of Tubal Pregnancy are gradually being filled in. It is true that well preserved early specimens of the disease are not easily obtained but when obtained it is not always certain that the method of consecutive section is uniformly adopted. It is the only means of seeing the whole picture and also of avoiding erroneous conclusions so apt to be made if only a few sections be cut. The question for example of how the ovum actually embeds itself, can only be settled in this way, but up to the present time we can only point to one really early ovum which has been described and in which the process of embedding can be studied viz. the ovum of Peter's. The ovum which I shall endeavour to describe is about 21 days old and presents many features of great interest and also points directly to diverticular embedding as a very frequent factor in the causation of Tubal Pregnancy. Observers who have studied the diseases of the corpus luteum have pointed out that the ovum which leaves a follicle which is the seat of a lutein

cyst may be itself diseased and may be prone to embed itself in an abnormal position. Such a cyst was present in the ovary of the same side in my case but the number of recorded instances of this are not numerous enough to draw conclusions from. I shall, however, have occasion to refer to current theories regarding the corpus luteum, in the clinical portion of this paper, with the object of testing their value in practical diagnosis.

Recent Advances:

But while much remains to be done, we must not forget the enormous advance which has actually been made within even a few years. The aetiology of Pelvic Haematocèle is now regarded to be in the vast majority of cases due to a Tubal Pregnancy gone wrong and there is little question now as to the proper treatment of the condition when met. The patient is not kept under observation now-a-days for weeks with the hope that spontaneous absorption might occur but with the result that she usually died of some form of sepsis. The operative mortality, excluding those bad cases of intra-peritoneal bleeding which are too late for operation, is now practically at vanishing point. With this great advance in operative technique there is all the

more room and opportunity for workers on the minute anatomy of the disease and there are still many unsettled problems with some of which I shall endeavour to deal in the course of this discussion.

MATERIAL:

First a word may be said as to the material on which I have based the present paper. It includes:

(1) A consecutive series of 500 sections from an Isthmian Gestation of about 21 days duration (vide Case 94). The tube was just ruptured but was in a perfect state of preservation. A drawing of it is shown on sheet 16 (No.1).

(2) A series of twenty consecutive sections of a ruptured ampullary gestation of about 3 months duration. Here the foetus was actually alive and the sections are intended to exhibit the placental area. Vide sheet 16 (No.2).

(3) Microscopic details of 10 Tubal Pregnancies at various stages of development shewing villi and tubal mucosa normal and otherwise. Those sections were made not in consecutive series, the specimens not being in good preservation but consisted of

ragged tube wall and portions of blot. They are detailed in the list of analysis for the year 1907.

The clinical portion of the paper is based upon a series of 95 cases of tubal gestation taken chiefly from the records of the Chelsea Hospital for Women; 14 of them came under my own personal care and observation as Resident Physician there during the year 1907. I shall also refer to an interesting case of Isthmian Gestation which went almost to full term. This case came under my care at Queen Charlotte's Lying-in Hospital during my period as Resident Physician in 1906. The conclusion that the original implantation of the ovum was in the Isthmus I drew from the fact that the tube lumen, while patent from the ostium to the isthmus, became lost and spread out at that point over the gestation sac. The relative position of the round ligament in front of the sac wall also warranted that conclusion.

(2) During the course of the paper I shall take up and contrast the symptomatology of Tubo-ovarian Abscess and that of Tubal Pregnancy and for this purpose I have tabulated 15 cases of the former condition. Those cases I have either attended personally or have taken from the records of the Chelsea Hospital for Women. The differential

diagnosis of the two conditions is sometimes peculiarly difficult and in its discussion I shall have occasion to refer to the prevailing theory as to to the function of lutein cells in the control of menstruation.

As I have mentioned above my series amounted approximately to 500 sections. Out of this number I have stained and mounted every sixth specimen. The stains I used were logwood and eosin. The specimen was first hardened for three days in 2% formalin in saline, then in various strengths of alcohol up to absolute alcohol. It was finally divided into convenient blocks and embedded in paraffin. An ordinary Cambridge Rocking Microtome was then employed and the sections carefully mounted on slides coated with egg albumen. Many of the series I have either photographed or drawn and I shall have occasion to refer to these individually. The microscopic details which I shall refer to I have hand-drawn. To my regret I have been unable to obtain the use of a micro-photographic apparatus and have entrusted to diagram the demonstration of what might have appeared to more advantage in photograph. Those photographs I shew were done by contact on lantern slides and then enlarged about five times in a magnifying apparatus. They are superior

to the hand-drawn specimens in giving relative proportions more exactly. The actual mechanism of rupture is, however, better shown in these specimens I have drawn. For my knowledge and ability to recognise the various appearances presented by Langhans cells and syncytium I have been greatly indebted to sections which through the kindness of the pathologist, Dr Taylor, I obtained from a case of chorio-epithelioma. This case occurred during the year 1907 and was under my care. The patient died a week after operation with symptoms of pulmonary metastases and secondary deposits were found in liver, lungs and brain. I thus came into possession of sections showing typical foetal ectoblast and have used those to some extent in contrasting foetal cells with decidual cells.

Finally, I must refer to the sections of normal tubes which I was able to obtain through the kindness of Dr Taylor, the Hospital Pathologist. They were taken from patients who had some collateral condition chiefly uterine fibromyoma and were as nearly normal as we could get them. The results obtained are referred to below and are compared with the findings of Ballantyne & Williams in their valuable paper which appeared in the British Medical Journal, 1891.

HISTORY OF THE SUBJECT:

Before proceeding to the actual description of my specimens, I may add a short account of the History of the Subject. The attention of ancient and mediaeval writers seems to have been quite frequently called to this disease by the appearance of foetal bones in process of ulceration either through the umbilicus or the vagina. Cases in which a spurious labour had occurred and where the foetus remained incarcerated in the abdomen till it became calcified or putrid were as one might expect common, but their true aetiology was quite unknown. In some instances they were thought to be large dermoids of the ovary and in others were regarded as cases of primary abdominal pregnancy. Modern history of the disease, however, began when Lawson Tait performed the first abdominal section for pelvic haemorrhage. This occurred in the year 1883. His first case, strangely enough was not awarded with success, but was soon followed by the publication of six successful cases. At this time current theories as to pelvic haemorrhage were built on the flimsiest foundation. Recamier, Bourdon, Velpeau and Bermitz had all recorded cases. Bernutz had laid down the theory that many of the cases could be explained on the hypothesis of menstrual re-

gurgitation. Other explanations were, rupture of an ovarian aneurism, or rupture of peritoneal or sub-peritoneal veins. "A priori" reasons such as pelvic congestion due to menstrual irregularities were loosely given regardless of any foundation in real anatomical fact. It is to Lawson Tait we are indebted for the masterly manner in which he placed the subject of these haemorrhages on a scientific basis. He recognised that in the vast majority of cases they were due to some disturbance of a Tubal Pregnancy, viz. the rupture of the gestation sac and this rupture Tait explained was brought about by the thinning and stretching of the musculature of the tube caused by the growing ovum.

The work so ably initiated by Lawson Tait was equally ably carried forward by Bland Sutton in this country and almost contemporaneously by Werth in Germany. With these observers Lawson Tait was never able to see eye to eye regarding the origin of the tubal mole. They had called attention to the frequency with which prior to rupture, haemorrhage into and around the ovum occurred. In 1889 Bland Sutton demonstrated the resemblance between a tubal and uterine mole and asserted at the same time that if a careful search were made a mole would be found accompanying every pelvic haematocele.

Around this problem an acute controversy raged for many years ending as so many controversies do, in a wise compromise. From the frequency of operative procedure evidence began to accumulate rapidly. It was now demonstrated that haemorrhage into the pelvic peritoneum could occur without tubal rupture, as a slow leakage through the abdominal ostium giving rise to the encysted type of pelvic haematocele, as opposed to the diffuse type which resulted from actual rupture. While it had thus for some time been recognised that the diffuse type of haemorrhage was associated with extra-uterine gestation, it was not until a much later period that observers realised that the encysted variety was also connected with tubal gestation. In other words it was recognised that the diffuse and highly dangerous type of intra-peritoneal bleeding was due to rupture, while the comparatively safe and encysted type was due to something which resembled an abortive act on the part of the tube.

Para Tubal Haematocele:

It was finally left to Sampson Handley to prove that that variety of haematocele called para-tubal was also associated with tubal gestation. In 1902, in a contribution to the Obstetrical Society of London, he showed that a slow leakage occurred not

from the abdominal ostium itself but from a very closely associated rupture. This, as I shall shew later, is a frequent termination of a Tubal Pregnancy and may occur with the lumen of the tube still intact the gestation sac having occupied an intramural position throughout. We thus see how out of the heterogeneous class of conditions which before the days of Tait were grouped as pelvic haematoceles, have arisen one by one the various types of tubal gestation and its terminations. One by one the numerous varieties of pelvic haematoma have followed suit, the only difference being that some form of intra-ligamentous rupture has confined the resulting haemorrhage within the connective tissues of the pelvis.

HISTORY OF THE ANATOMY OF TUBAL PREGNANCY:

Turning now to the gradual increase of our knowledge of the Anatomy of the Pregnant Tube we find that it was not until the year 1898 that Fürth, a German observer, demonstrated a 2½ weeks ovum developing in the wall of the tube, lying entirely outside the lumen of the tube and separated from it by a layer of muscle. Up to this time the ovum was held to be situated during its development in the lumen of the tube. Playfair in his Textbook

of Midwifery, 7th Ed. says, "When the ovum is arrested in any part of the fallopian tube, the chorion soon commences to develop villi just as in ordinary pregnancy which engraft themselves into the mucous lining of the tube, and fix the ovum in its new position. The mucous membrane becomes hypertrophied much in the same way as that of the uterus, so that a pseudo-decidua comes to be formed. Inasmuch, however, as the mucous lining of the tubes is not furnished with tubular glands, a true decidua can scarcely be said to exist; nor is there any growth of membrane around the ovum analogous to the decidua reflexa. The ovum is, therefore, comparatively speaking, loosely attached to its abnormal situation and hence haemorrhage from laceration of chorionic villi can very readily take place."

In fact the science of obstetrics seemed to be dominated for years by the theories of William and John Hunter in regard to the embedding of the ovum. Even before the ovum reached the uterus a well developed decidua vera was supposed to be awaiting it whilst a decidua reflex was prompt to sprout up around it the moment the latter settled at any point of the uterine cavity. But since the year 1898 when Fürth published his case, a large number of observers have placed the fact beyond doubt that in

the tube, at any rate, the ovum develops in a sac which is strictly intra-mural.

Peter's ovum:

In 1899 a very great step in advance was made by Peters who was lucky enough to discover a very early human ovum and also "pari passu" the youngest specimen of human placental development. The whole ovum was calculated to be about a week old and was embedded in the maternal decidua. At the point of embedding there was a slight projection into the uterine cavity and on the apex of this there was a small break in continuity of the uterine epithelium. This was covered by a cap of fibrin, resulting from haemorrhage and indicates the probable point at which the ovum had penetrated the uterine epithelium. These appearances have led to the conclusion that immediately after entering the uterus the fertilised ovum penetrates the uterine mucosa destroying the surface cells and embedding itself in the sub-epithelial tissues - a totally different conception to that of the Hunters which relegated to the ovum a perfectly passive rôle whilst the formation of a reflexa was handed over to the activity of the uterine decidua. And in addition, this new rôle of the ovum in burrowing its way through the uterine epithelium, throws a new light on its deeply situated

position in the tubal musculature.

COMPARATIVE EMBRYOLOGY:

If we glance now at the evidence which is borne by comparative embryology we find that it throws remarkable light on the appearances presented by my specimens. In 1889 Hubrecht published a monograph on the placentation of the hedgehog and showed that the developing ovum becomes embedded almost immediately in the sub-epithelial portion of the uterine mucosa. This embedding was effected by the action of the ectodermal cells of the blastocyst. These cells he called trophoblast because of their nutritive function. Von Spee has shown in the bat and guinea-pig and Arthur Robinson in the Rat and Mouse that the greater part of the ovum in the blastocyst stage consists of this trophoblast. By a reference to Peters' specimen it will be seen that the most striking feature in early development is the enormous size of the trophoblast as compared with the rest of the ovum. My specimens will be found to bear out the same facts. While the amnion with its developing embryo is in most sections practically unrepresented we find the chorion with its surrounding trophoblast invading almost every structure in the tube wall. Far from existing as a passive

agent as the older authors would have us believe its great activity, especially its destructive activity is present at every hand. We find it delaminating muscle fibre and altering its chemical constitution, invading the maternal vessels until it dips into their lumen, spreading along the connective tissue spaces and calling forth a decidual change in the connective tissue corpuscles and finally destroying the peritoneal covering of the tube itself.

Description of the trophoblast:

Although I shall have occasion below to contrast the cells included in the trophoblast, viz. Langhans' cells and syncytium with decidual cells, it seems essential and convenient here to state what I include under the term, when used in connection with my drawings. Amongst recent authors whom I have consulted on this point, the monographs of Russell Andrews and Arthur Robinson seem the most succinct. According to these authors the "trophoblast is the original undifferentiated cell mass which surrounds the early ovum; in other words the chorionic ectoblast. It becomes early differentiated into two layers, an inner layer composed of Langhans'cells and an outer layer of undifferentiated cellular protoplasm called syncytium villi are formed by the projection of chorionic mesoblast into those masses

and are thus composed of a core of mesoblast clothed by two layers of epithelium". It must be remembered, however, that the appearance of each specimen varies with its age. The description above, applies exactly to my 21 days ovum but in the specimen taken at the 12th week the original trophoblast has for the most part disappeared and only villi are present clothed by a single layer of cubical epithelium but surrounded by an exuberant growth of decidual cells (vide Drawing No.15, D2). It would appear that between the 6th and 12th week the activity of the trophoblast disappears, thus limiting the growth of the placenta at the expense of the maternal tissues and no Haft-Zotten such as those represented in the above drawing can then be formed. There are thus two stages in the life history of the trophoblast. The first is its active initial stage during which great destruction of maternal tissue goes on. The destructive agents are Langhans' cells and syncytium. The second stage may be described as the passive phase. It begins with the ingrowth of chorionic mesoblast, with the formation of villi but with the gradual disappearance of Langhan's cells and syncytia. The first stage ends from the 5th to the 6th week and is gradually succeeded by the second which ends only with the detachment of the placenta.

Be this as it may, it is evident that the discovery of Peters together with the work of many observers in comparative embryology has paved the way to a rational explanation of the intra-mural site of the gestation sac in tubal pregnancy. That the growing ovum provides its pabulum out of the destruction and absorption of maternal tissues until the villi by ingrowth of mesoderm with its blood supply are able to undertake the function, is now if not an accepted fact, at least the best of working hypotheses. The implantation of the ovum in the uterine wall is thus seen to be as much extra-uterine as that of the tube is extra-tubal. The only difference is that decidual tissue in the one is represented by muscular tissue in the other, at least as far as a pseudo-capsularis is concerned. We have yet to see how far, of course, a decidua basalis is formed in the tube.

Decidual reaction in the tube:

Having thus shortly reviewed the history clinical as well as pathological of tubal gestation, pointing out some of the chief landmarks in its advance I proceed to deal more fully with the problem of decidual reaction as shown in the pregnant tube, at the same time pointing out the appearances I have met with in the normal tube. I have already

indicated that various interpretations have been given by different observers of the nature of the decidual change in the tube. That a placenta is actually formed in the later stages of gestation no one doubts who has had much experience of the disease. On sheet No.16, drawing 3, may be seen a placenta ¾" thick completely lining the tube with a well developed foetus. The question is, how far is this composed of maternal and how far of purely foetal tissues. Clarence Webster was one of the first observers to deal with the subject from a purely anatomical standpoint. In 1895 he endeavoured to show that certain changes he had noticed in the deep layers of the tubal mucosa represent a decidual formation and his observations led him to formulate a theory of Reversion or Atavism to explain the occurrence of the disease. His theory was that the condition is one of reversion to an earlier type of mammalian evolution, where a decidua is produced in a larger portion of the Mullerian Ducts. The ovum would thus be able to implant itself at whatever portion of the tube a decidua was produced. This will be readily seen to involve the false standpoint promulgated by the Hunters and continued by the older authors, viz. that decidua cells were present prior to the arrival of the ovum and were necessary for its safe implantation.

We now believe that the trophoblast is first and that its presence is necessary for the appearance of decidual cells. Webster's theory thus fails to meet the real facts of the case.

Again Bland Sutton in 1896, Surg. Diseases of Ovaries and Tubes declares "that from a thorough and careful examination of gravid tubes in exceptionally early cases of tubal pregnancy he has failed to find anything that might be regarded as a tubal decidua - certainly nothing that is cast off in the form of a membrane and this is the real qualification for a decidua". But while clinically a decidua may be said to be something cast off yet it is evident that anatomically it need not fulfil that condition. Anatomically a decidua whether cast off or not is a tissue containing groups of the typically large cell which arises from the connective tissue cells already present incited to growth by the invading trophoblast. On the other hand, evidence in favour of a definite decidual reaction appeared in 1900 when Orthmann described a case in which he could differentiate a decidua reflexa and scrotina.

Russell Andrews in 1902 describes decidua-like cells in the tubal submucosa. The amount of decidual formation varies in his specimens. In some tubes he finds it close to the ovum and in others at some

distance. In two of his sections decidua cells are seen in the mucosa folds close to the ovum but in the majority no decidua cells are seen in sections which show part of the ovum. In his sections intermuscular connective tissue cells are enlarged and decidua-like but not so large as those seen in the mucosa folds. He also exhibits decidua-like cells in the ovary belonging to the pregnant tube and concludes that in healthy tubes the formation of a complete strata compacta might be anatomically possible in tubes which had been the subject of salpingitis.

Again later, in 1905 Berkeley and Bonney by the method of serial section examined several cases of early tubal gestation and state that the absence of any connective tissue reaction to the invading trophoblast is the most striking feature of their specimens. Here and there they find patches of small cells with single round deeply straining nuclei, whilst scattered irregularly in the muscle tissue are certain cells with oval vesicular nuclei which stain faintly with haematoxylin. These they term decidua-like. Again still later in 1906 Jl. of Ob. & Gyn. Haultain figures an interesting condition of deciduation in the opposite tube to that containing the gestation sac where he was able to differentiate both a spongy and a compact layer. The age of the gestation is however not

mentioned. These instances are quite sufficient to indicate the extreme divergence of opinion as to the presence or absence of a tubal reaction. Bland Sutton found no indication at all of a tubal decidua; Russell Andrews found collections of decidua-like cells in the plical folds but not in the intermuscular tissue, Berkeley & Bonney found them chiefly in the latter site while Haultain finds a well developed spongy and compact layer. To arrive at some uniform standard at the outset two factors must be taken into consideration, viz. the age of the gestation sac and the activity of the invading trophoblast. Clearly nature has intended a decidua to act as a line of defence but if the attack be so violent and delivered so suddenly that no time is given to throw out this line of defence, then no decidua can be expected. This I take it explains its absence in those early cases described by Berkeley & Bonney. The whole of nature's resources are as it were destroyed at a blow. The attack has been dealt at her weakest point viz. where the sub-epithelial stroma is at a minimum and the invader in search for pabulum finding this stroma insufficient deals a yet more powerful blow at the musculature of the tube. This being still more feeble in its powers of reaction, the end is an overwhelming diaaster. But where the invader has been stayed in his devastatory course and where time has

been given nature to rally and to accommodate herself to the new conditions there a decidua will be found, not indeed approaching the thickness or differentiation of a uterine decidua but a structure which would act for a time as a physiological substitute for a fully formed placenta, and which I shall describe in the detailed account of my specimens. Sections of my 21 day ovum, as we shall see, show a purely passive musculature but a decided reaction on the part of the sub-epithelial stroma exactly homologous with that shown by the corresponding uterine tissue in uterine pregnancy but with all the anatomical deficiencies which the former shows when compared with the latter. Not only so, but my three months specimen shows a larger numerical increase and closer aggregation of decidual cells in the same position (vide sheet 15, No.2) thus bearing out my contention that duration of time is a most important consideration in the estimation of the extent to which deciduation may occur in the tube.

The Normal Tube:

The contrast between the uterine endometrium and the mucosa lining the tube is indeed as marked as their reactions are different to the stimulation of a developing ovum and for the proper interpretation of

the one, a clear understanding is required of the other. As I have already stated I have made sections of normal tubes for this purpose and in addition have examined the endometrium in a few cases of early uterine pregnancy where the uterus has been removed for fibromyoma. The chief difference would appear to lie in the larger amount of sub-epithelial connective tissue stroma and also in the presence of tubular glands in the uterus. In the uterus a decidua is formed by changes in this sub-epithelial stroma. The connective tissue corpuscles become increased in number and in size. The glands become hypertrophied and dilated. The epithelium lining these glands becomes more cubical and proliferates to such an extent that small clumps of cells may be seen projecting into the lumen of the gland. Thus far seems certain that decidua cells arise not from epithelial but from connective tissue cells which are mesoblastic in origin. Examination of a section of early uterine decidua enables us to trace transition forms from unaltered connective tissue cells in the deep layer to the typical decidual cell in the superficial layer. There is also increased vascularity. Capillaries become dilated and interstitial haemorrhages become abundant.

In the normal tube, on the other hand, there is

a lining of one layered columnar epithelium set on a basement membrane. In the isthmus it is thrown into simple folds while in the ampulla those folds are more complex. The folds are composed in addition to a surface epithelium of a fine fibrillated connective tissue into which longitudinal muscle fibres are projected in some instances. This fine fibrillated connective tissue is well shown in sheet 15, D.No.3 taken from a normal tube. Outside this again we have several layers of circular muscle fibres constituting the circular coat. This is more largely developed in the region of the isthmus. The circular coat is then surrounded by several layers of longitudinally directed muscle fibres with a much looser arrangement and larger intervals of connective tissue lacunae. This coat shows its greatest development at the ampullary portion of the tube. The most vascular portion of the organ is situated at and around its attached border. Here the vessels are larger and more numerous and towards this region as we shall find the trophoblast tends chiefly to spread. The area, however, between the basement membrane on which the epithelium rests and the circular muscle fibres is all we have to represent a submucosa in the tube. Mandl denies that such a submucosa exists. Although I have frequently found columnar epithelium

immediately set on the muscular coat in the interplical areas yet as far as the plicae themselves are concerned, I have never found a submucosa awanting. Russell Andrews has called attention to the subepithelial layer of connective tissue which is found in the tube and it is round this layer that the question of decidual reaction is chiefly centred. In the sections of normal tube which I cut this layer, as I have already indicated, was constantly present in the plical folds and occasionally in the interplical areas of the isthmus specially. It consisted of a basis of round and spindle shaped cells with a central connective tissue stroma. According as there had been more or less salpingitis these cells were larger and more numerous. If anything it was more uniformly present and more developed in the isthmus than in the ampulla and in this my observations agree with those of Ballantyne & Williams, British Medical Journal 1891. Those authors in addition to examining 94 pairs of adult tubes also examined the tubes in the foetus and in children at the several ages of 3, 4 and 5 years. They state that in the foetus and infant the tube reveals an extremely cellular submucosa, both in the isthmus and ampulla but more abundant in the former, and in children while the submucosa was still cellular in character that a

slight intermixture of fibrous tissue was present. In a seven months syphilitic foetus, it may be noted in passing they found many of the tubal folds adherent at their apices forming transverse bands. This will be referred to in the aetiological portion of the paper. Thus we may conclude that as contrasted with the uterine endometrium, the tube mucosa is thin and one-layered but almost constantly with a definite sub-epithelial stroma in the mucous folds. "A priori" then there is no ground for denying the initial ability of the tube to start a decidual change. Again it usually stated that the tube is devoid of glands but a second reference to sheet 15, No.3 will show the presence of involutions in the mucous membrane which might quite well be regarded as tubular glands. A bird's oviduct,for example, which is no more complex than the human fallopian tube, has a most complex function assigned to it. It supplies the albuminous investment of the egg and also undertakes the subsequent deposition of a calcareous coat. The oviducts of frogs, lizards and tortoises are provided with complex glands and many mammals show a much more complex structure than does the human female. "The question" as Bland Sutton says in Surg. Dis. of Tubes & Ovaries"is not one of fact but of interpretation of the facts". However we may

interpret those, there seems no doubt that during a tubal pregnancy the plical involutions act merely passively. They do not hypertrophy as the uterine glands do, nor do they become dilated. The change undergone is merely atrophy to a lower type, viz. cubical epithelium and in many places as we shall see, the chief change is a desquamative change. In the tube then, the ovum once it has burrowed beneath the surface epithelium very soon finds its way into the muscular tissue. The sub-epithelial stroma is not sufficient in amount, nor does it react quickly enough to prevent this. The primary gestation sac is thus found in its earliest stage embedded in muscular tissue. In the uterus, on the other hand, the trophoblast is perpetually being confined to the decidua which hypertrophies simultaneously with the growing ovum. In the tube destructive changes are at a maximum leading to a succession of haemorrhages which finally destroys the growing ovum. There is neither muscular hypertrophy nor decidual formation to anything like the extent found in the uterus but that an attempt at a decidua is made and that a decidua forms just so far as the anatomical structure of the tube will allow, I will show in detailing the serial sections of my ovum.

Contrast between Decidual and Foetal Cells:

With a word on the distinguishing features of decidual cells and foetal ectoblast I shall proceed to the microscopic details of my specimens. No one can have approached the minute anatomy of the pregnant tube without at length discovering the excessive difficulty of differentiating decidual cells from those described by Langhan. They occur in many instances mixed up in such an intricate fashion that some lines of distinction must be drawn between the two varieties.

Kühne's description:

Kühne has described this difference and says they are frequently confused. Decidual cells, he says, are round, sometimes oval or spindle-shaped. The cell borders are sharply defined and the protoplasm is clear. The nuclei are large and of a regular oval shape. They may be round and show a strikingly pale staining. The cells lie close together but a fine mesh-work of connective tissue can be seen running in the inter-cellular spaces. Langhan's cells, on the other hand, are about the same size as decidual cells, but their shape is different. They are usually polyhedral and lie tightly packed together, pressing against each other. Their protoplasm is clear. The nuclei stain deeply and show

an indented irregular form. They can usually be traced to a villus." With this description my observations agree in the main but as regards size, I have found that the well developed decidua cell is distinctly larger than the Langhans. I have observed many individual instances where the decidual cell was at least one and a half the size of the largest Langhans cell in the field. The nuclei of decidual cells are relatively smaller and do not show the bladder like appearance so uniformly seen in the case of Langhan's cells. The Langhan's cells also appear polyhedral in character and as contrasted with the rounded decidual cell this characteristic has enabled me in several instances to pick them out. The relative staining power of the cell protoplasm has not been of great help but on the whole the decidual cell protoplasm stains better than that of Langhan's cell. In tracing the origin and nature of a cell I have thus depended on the following points:-

(1) Shape polyhedral (Langhan's)
If rounded (Decidual)

(2) Nature of the interstitial stroma. Decidual cells have usually a larger amount of connective tissue surroundings. They are in fact lying in

lacunar spaces and can be traced through various gradations to the unaltered connective tissue corpuscle, (see Drawing No.11). The appearance of syncytium, Langhan's cells and decidual cells are also contrasted in Drawing No.12.

(3) Langhans cells lie in clumps and can often be traced to a neighbouring villus.

(4) Nuclei of decidual cells stain more deeply with logwood than do Langhan's.

(5) The cell protoplasm of Langhan's cells reacts to alkaline stain while that of a decidual cell takes on acid stain more readily. In all cases of doubt I have tried to follow the origin of the cell. Syncytium has never caused any doubt as it is usually lying free in some space or other. (vide Drawing 12).

Having thus discussed briefly the chief anatomical features of the trophoblast and decidua and having glanced at the anatomy of the normal tube and contrasted it with that of the uterus, the way seems clear to the detailed description of my specimens.

Description of the Specimens:

As I have already indicated these consist of pathological material taken from 14 cases of tubal pregnancy which came under my care at Chelsea

Hospital for Women. They are clinically detailed in my appended analysis No.81 - 95 inclusive. Three of these cases I call separate and special attention to viz. 89, 92 and 94. Cases 89 and 92 had each progressed to the 11th or 12th week and sections shew in many areas a well developed stratum compactum, while case 94 is that of which I cut 500 consecutive sections. There had been a period of about seven weeks amenorrhoea but the specimen appears to be a growth of about 21 days. The gestation had occurred at the isthmus. There was a small rupture in the posterior wall of the tube and free blood in the peritoneal cavity. The ovary contained a large cystic corpus luteum and the ostium was quite patent. The cross section of the gestation at its widest portion measured two centimetres. The drawings as I have before stated are semi-diagramatic.

Drawing No.1 illustrates the appearance of the first few sections of the tube towards the uterine side of the isthmus. There is no rupture present and no haemorrhage. The tube lumen is intact and its mucosa normal. Amongst the longitudinal fibres is seen the cell sheet composed of trophoblast with round celled infiltration. Langhan's cells are seen invading the musculature and masses of syncytia

invading venous channels. Drawing No.2 is taken from a H.P.$\frac{1}{6}$ view where one of these masses is seen occupying the lumen of a vein. Drawing No.3 and photograph No.1 illustrate sections taken from the tube a little nearer the gestation sac. Here the first appearance of a haemorrhage presents itself into the gestation sac which occupies a position in the longitudinal coat. Tube lumen is still intact and its mucosa still normal. The peritoneal covering of the tube is still intact but a slight fibrinous deposit is present where rupture is about to occur. The intramural haemorrhage is surrounded by primary sac wall, or pseudo capsularis composed of a few layers of fibrin and altered muscle. This muscle is undergoing a hyaloid change and beyond this lies the cell sheet composed of mucleated masses of protoplasm, Langlan's cells and round celled infiltration. No decidual cells are yet present in any part of the field. A great peri-vascular infiltration is observed around many of the larger vessels. The cell sheet tends to become concentric and to extend downwards towards the maso-salpinx.

Drawing No.4 and photograph No.2 illustrate sections still nearer the actual gestation. Here there is an enlargement of the haemorrhage which is now seen to contain a portion of amnion together with a villus. There is also a great extension of tropho-

blast. Longitudinal fibres are becoming concentrically delaminated and more deposits of fibrin are found on the external surface of the tube. The haemorrhage is surrounded by the gestation sac wall composed of fibrin and hyaloid muscle. The trophoblast spreads towards the meso-salpinx by the splitting up of muscle fibre.

The process of enlargement of the haemorrhage is well shown in photographs 3, 4, 5 and 6, where it is seen gradually making its way to the surface preceded by trophoblast which by its phagocytic action on the walls of vessels prepares the way for more haemorrhage. The fibres of the longitudinal coat become more and more separated until actual rupture is seen occurring in Drawing 5. Here, however, several layers of fibrin have been added to the surface and this for a time delays an inrush into the peritoneal cavity. The primary gestation sac wall or pseudo-capsularis is still intact. Notice still the concentric delamination which tends to spread along with the trophoblast into the meso-salpinx. An appearance presented in Drawing No.5 and also in photo No.IV. is that of an apparently double lumen. The accessory lumen is a diverticulum from the main stem and lies between it and the gestation sac. Doubtless the ovum was primarily caught in this and by a process of burrowing

found its way immediately into the longitudinally directed muscle fibres. The wall of the tube lumen is still intact as is its mucosa although some haemorrhage is now present in the lumen, having spread from the seat of rupture. It may be noted in passing that the usual descriptions place the earliest gestation sac between the circular and longitudinal coats, but in my specimens the ovum lies primarily amongst the longitudinal fibres. This would appear to be due to the excursion which the presence of a diverticulum has given to the ovum as the former presents a cul-de-sac lying amongst the longitudinal fibres.

Drawing No.6 shews an interesting phase in the extension of the gestation sac. Photographs No.4 and No.5 must be referred to at this stage. The longitudinal coat has finally ruptured and only fibrin remains to exclude the products of gestation from the peritoneum. One plica in the diverticulum is seen to be enlarged and on closer inspection this enlargement is found to be caused by a process of decidual reaction. In the drawing this plica is seen to occupy the centre of the diverticular lumen and at first sight might be confused with a villus. This, however, is negatived by the fact that there is a covering of columnar shaped epithelium. The lumen of the main tube now also contains sections of degenerated villi, which by extension from the seat of rupture have found their way there.

The gestation sac contains numerous villi with an amniotic sac. Note the swelling up of cells in the sub-epithelial stroma of the diverticulum.

The appearance of this plica under $\frac{1}{6}$ P is shown in drawing 6A. There is a projection of longitudinal fibres into this area but amongst the connective tissue stroma are lying cells which are larger than Langhan's cells; the cell protoplasm is more eosinophilic and the nucleus has not the definite vacuolated or bladder-like appearance seen in the nucleus of Langhan's cells. Besides no actual syncytium is seen in this part of the field, and the largely developed connective tissue stroma surrounding them show plainly their origin in situ. That is, they are typically decidual cells.

The interest of the following sections lies chiefly in this small area at which we find a tubal plica taking on a decidual reaction. While the actual trophoblast has extended outwards towards the circumference an attempt at a decidua scrotina has occurred around the diverticulum. Photographs No.5, 6, 7 will serve to show this and also the drawings on sheet No.7 in a purely diagrammatic way. In these we see the diverticular lumen being gradually obliterated by the extension of this placenta-like formation. The lining of columnar epithelium becomes stretched and finally gives way. Haemorrhages then follow and finally

rupture into the diverticulum until its lumen is totally obliterated. Drawing No.8 is a representation of what is seen just at this area of epithelial rupture. The epithelium is observed to be cubical, stretched and desquamating. Decidual cells are seen at various stages of growth and longitudinal muscle fibres are swollen and hyaloid. The actual stretching and rupture into the diverticular lumen is thus brought about not by the eroding action of the trophoblast but by the swelling out of muscle fibres and by decidual formation in the sub-epithelial stroma. Drawing No.9 is a good representation of this deciduation and rupture. It is taken from a somewhat earlier section in the series, and although it shows a considerable aggregation of cells yet nothing approaching the appearance of a well developed compact layer. In fact, a patchy deciduation is characteristic of this 21 day ovum eminently in contrast with that seen in the two specimens of 12 weeks growth. Drawing No.9 shows remarkably well how far the sub-epithelial stroma in the tube can go in the formation of a decidua before the epithelium is compelled to rupture leading to extravasation of the gestation products into the lumen. The total absence of any support from the rest of the sub-epithelial stroma is also evident. While a decidua vera invests the whole of the uterine endometrium,

the most marked condition in the tube is the inaction shown by the surrounding plicae. Whether the ovum burrowed just at this point in the diverticulum or not, cannot be proved but that an actual attempt at decidual hypertrophy has been made, the microscopic evidence can hardly leave us in doubt.

The succeeding drawings show the various stages of rupture of the gestation sac into the lumen of the tube. The diverticulum having been canalised the path into the principal channel is thrown open. The amount of haemorrhage gradually increases and is confined within the primary gestation sac until the intrasaccular pressure is so great as to rupture the sac wall. Blood then distends the lumen first of the diverticulum and then of the tube itself. Drawing No.10 shows those stages. The products of gestation soon follow in being extruded either in the direction of the tube lumen or into the peritoneal cavity. The amniotic cavity with its embyronic content is compressed and the developing ovum totally destroyed. Photographs 9 - 15 show all the progressive stages in the formation of a typical tubal mole.

Although the actual embryo has been destroyed, the tube mucosa may still continue to show some decidual changes. Drawing No.11 for example, shows a villus in contact with a tubal plica from which the epithelium

has been denuded. It shows decidua-like cells in various stages of growth and with such a close aggregation in places as to resemble a compact layer. A stratum spongiosum is, however, not formed but in some positions a somewhat close resemblance is seen to be brought about by the presence of lacunar spaces due to separation of muscle gibres. These spaces are quickly filled with blood and villi may be seen dipping into them. Drawing No.12 illustrates the diagnostic points which I have already discussed in regard to the differentiation of Langhan's and decidual cells. Those Langhan's cells which were drawn, were found chiefly in the sub-peritoneal connective tissue where they were specially active and numerous. Decidual reaction was here totally absent as it was also in the intermuscular connective tissue. It was only definite in the submucosal connective tissue and chiefly in one or other of the plical folds. Again, although anatomically the tubal mucosa may appear gland-like, no section shows any attempt at hypertrophy or dilatation on the part of those glands. On the other hand, the epithelium seems the most vulnerable of all the tissues in the tube.

Drawing 12 shows in addition typical examples of nucleated protoplasm also found chiefly in the connective tissue spaces closely underlying the peritoneum. There it has been most active and may be seen

embryonising almost every structure it comes in contact with, muscle fibre, vein, artery and lymphatic. The reaction of the larger artery is indeed interesting. First the muscle fibres of the longitudinal coat swell up and undergo a fibrinisation or hyaloid change. The circular coat is then attacked in the same way and undergoes great enlargement, with a simultaneous constriction of the lumen of the vessel. The question of auto-thrombosis will be discussed below.

Sheet 13 shows more minutely some of the final stages, viz. rupture of the primary sac wall including chorion. This results in the escape of the actual ovum, viz. amnion, with villi and blood, into the peritoneal cavity. No.1 sheet 13 shows the gestation sac still unruptured with many appearances of decidual reaction in the tubal submucosa. No.2 shows the rupture of sac wall and chorion. No.3 shows the tubal epithelium reduced to a minimum and corresponds to photograph XV.

On sheet 14 is shown a tubal plica with distinct decidual cells at its base and several haemorrhages at its apex. The epithelial lining is cubical and in process of desquamation. There is also drawn on sheet 14 the last stage in the formation of a tubal mole, showing the total extrusion of the amniotic sac with its surrounding villi. There is also shown

signs of haemorrhage into the amniotic cavity but no trace of nucleated red corpuscles although those were carefully looked for. The first haemorrhage into the actual ovum has been seen to lie in the space between the amnion and chorion in what has been termed the sub-chorionic space. The amnion remains free for a longer space of time being in reality a more resistant structure. Nucleated reds were not, however, present and the theory that this sub-chorionic haemorrhage is foetal does not gain any support. The extent of it compared with the actual size of the embryo makes the theory a most unlikely one.

The Second Series of Sections:

The next case of which a less extended study was made in serial section is case 92 in the clinical series. The gestation had continued till the 12th week and a secondary sac had formed in the broad ligament. It can be studied in Drawings, Sheet 15, Nos. 1 & 2, and also in photograph No.XVI. It shows the deceptive appearance of an intact lumen bordering on the gestation sac but closer attention reveals the fact that the smaller lumen is produced by the kinking of the tube so often seen in tubo-ovarian abscesses. Drawing 2, sheet 15, shows two Haft Zotten surrounded by a well marked decidua. The case is chiefly interesting on account of the latter condition. Again

case 89,of which only a few sections were cut, had progressed to the 12th week and shows Haft-Zotten so similar to drawing on Sheet 15 that no special drawing has been made. The fastening villi are here situated in the longitudinal coat of the tube and the decidual cells are consequently not so well marked; a result in keeping with the sections from the 21 day ovum, where the muscular coats were seen to be almost purely passive.

The conclusions which I am able to draw from those details may be now referred to.

Conclusion:

First - That the gestation sac in tubal pregnancy is primarily intra-muscular. It is true that in the gestation sac of the 21 day specimen I have just described, rupture does occur into the lumen of the tube but a reference to the early sections of my series shows a sac quite intact and completely enveloped in muscle while the appearances presented by the later group of sections can only be interpreted by the view that rupture occurs from the wall of the tube into its lumen. Cases have been described where the gestation sac remains completely intact throughout in an intramural position. Berkeley & Bonney in Jl. Ob. & Gyn. 1905 have described such a specimen. Also Russell Andrews, Ibid.1903. Heinsius in 1901 described an

ovum entirely outside the lumen of the tube. Between the ovum and the lumen there is a thick layer of muscle. On the other side the ovum comes close up to the peritoneal coat. This is directly opposed to the observations of Couvelaire in "Etudes Anatomiques sur les Grossesses Tubaires" where he states that the ovum is embedded only at one pole while the other pole remains free in the lumen of the tube. When this was written, however, the ovum of Peters had not been described, and the evidence which has hitherto been accumulated entirely disproves it.

Conclusion:

Second - That rupture occurs in two directions, either into the peritoneal cavity, or into the lumen of the tube, or as in the present instance, into both.

In my sections two processes of rupture are going on simultaneously. The early sections in the series show a process going on at the periphery of the tube which is totally unlike that occurring towards the lumen of the tube. Towards the peritoneum we have the greatest extension of trophoblast - the cell sheet as it has been called. The longitudinal muscle fibres are being delaminated and are undergoing a hyaloid change being altered to what Nitabuch called a fibrin-looking material. No attempt at decidual reaction is being made by the sub-peritoneal connective tissue but

successive layers of actual fibrin are being deposited on the peritoneal surface, thus sealing up the rupture and protecting the peritoneal cavity. These deposits were early noticed by Stroganowa and in my specimens they appear to seal up the tube some time after the longitudinal fibres have given way. Leaking of blood must occur for many days before anything approaching a clinical haemorrhage can occur. The process resembles the oozing from the ruptured coats of a sacculated aneurism.

Thus we have a gestation sac with a periphery of trophoblast extending to the peritoneal surface while towards the tube lumen we have a decidual change going on. In a single tubal plica as we have seen decidual cells appear, arising in situ. The projected longitudinal fibres swell up and lose their nuclei while the epithelial lining becomes stretched, cubical and then desquamates. Meanwhile haemorrhages occur in this altered tissue and the "vis a tergo" becomes so great that at the weakest point where the tubal submucosa has remained inactive, the gestation sac ruptures into the tube lumen. The actual trophoblast has taken little or no part in this process. Its energies have been devoted to the opposite part of the tube where typical Langhan's cells are abundant.

Conclusion:

The third conclusion I draw from these specimens is the importance of the presence of diverticula in the tube, in the embedding of the ovum. It would seem obvious that the ovum on being wafted into this "cul-de-sac" and on finding its path barred must proceed to embed itself. Other cases have been described of diverticular embedding but at present I shall merely discuss the other possible methods leaving the rest to be discussed in the aetiological section of this paper.

Other methods of embedding. Kreisch and Werth have described a method of embedding which they termed inter-columnar, i.e. within two plical folds. In a tube where some degree of salpingitis has been present and where a certain agglutination of plical folds is left behind, it is not difficult to see that the ovum might thus be caught and compelled to embed itself in such a way. But serial sections have not been made to prove that it does so.

Then the ovum may be caught in the folds of one plica, especially in the ampulla where there are more glandular looking recesses than in the isthmus. Here rupture must occur very early and the ovum meet a more premature end than in the case of inter-columnar embedding. Microscopic evidence is again awanting.

Again, the ovum may embed itself in the basal mucosa, that is, in basal mucous membrane lying between two folds. This is again a mere possibility, as indeed all three methods are. We must await the forthcoming of specimens, where the ovum is actually found in the process of embedding before settling the problem, but this uncertainty seems to add some importance to the appearance in my specimens of a very early gestation sac lying close to the base of a distinct diverticulum. It has been said that these diverticula are primarily inflammatory but if so it is the only indication of inflammation which this tube presents. To my mind they are more probably developmental in origin.

Conclusion:

Fourthly - That as far as it is anatomically possible a decidual reaction does occur in the tube and chiefly in the sub-epithelial stroma; that this is less or more well represented according to the age of the gestation sac. It is to Russell Andrews we are indebted for pointing out the important part played by this sub-epithelial stroma in tubal pregnancy. In his own specimens he found a frequent reaction present in this stroma, and concluded that the thicker this part of the mucosa was, the more highly constituted would be the decidual reaction. His observations are, however, not supported by other observers. Berkeley

& Bonney, for instance, confining their attention to tubes containing 19 day, 24 day and 30 day pregnancies do not find any reaction in this situation. As I have already indicated, the cause of this great discrepancy among observers lies in the great discrepancy in age of the actual specimens examined. In two specimens at the 11th week I find a larger deciduation than in the 21 day specimen. Likewise Haultain in a case where the tube had carried a gestation to the 12th week finds the opposite tube lined with decidua from end to end. Whitridge Williams in Text Bk. Obstet. 1903, states: "I am confident that a decidual reaction occurs though to a far less extent than was believed by early observers. The decidua scrotina, never occurs as a continuous membrane but consists of a few patches". With this I agree but would add that the later developments of a tubal pregnancy are associated in many cases with an increase of decidual cells and that in my opinion variations in observations are due to too strict attention to the earliest cases.

Reaction in the Maternal Vessels. As I have already indicated, I have observed many interesting changes on the part of the maternal vessels. In the first place I have found masses of syncytia invading and projecting into maternal veins and lymphatics. This I consider the actual mode of production of those

successive haemorrhages which characterise tubal pregnancy. But quite recently Fellner has demonstrated a process of auto-thrombosis occurring in the larger arteries near the site of extension of the trophoblast. This thrombosis he considers is brought about by proliferation of the endothelium of the vessel. Von Franque and Garkish have also found decidual changes in the vessel walls. In the wall of a large vein they saw a beautiful picture of decidual change, the cells large, rich in protoplasm and containing large nuclei. My sections show appearances resembling this but the masses of cells are obviously foetal ectoblast. I have not found a process of auto-thrombosis occurring in this way but the walls of some medium sized arteries show a swollen appearance already described. The muscle fibres become so swollen as to give the artery a greatly thickened appearance. The inter-muscular connective tissue corpuscles become enlarged but never reach a stage which may be called decidua-like. The lumen of the artery thus becomes considerably constricted. The change affects the longitudinal coat, then the circular coat more slowly. Finally the endothelium desquamates but I have never observed complete auto-thrombosis in any of my sections. Turning to the other features of deciduation, we naturally come to a description of the quasi-reflexa or pseudo capsularis.

The pseudo capsularis. This structure in my specimens consists of three well defined layers. The innermost layer consists of fibrin, the middle layer consist of muscle which has undergone a hyaloid change while the outer layer is composed of muscle in process of fibrinisation amongst which trophoblast is burrowing. In half of my sections it is quite intact while in the other half owing to pressure of haemorrhage within the gestation sac it has ruptured first into the lumen of the tube and finally into the peritoneal cavity. This structure then is quite analogous to the decidua reflexa of Peters' ovum. The pole of this ovum does not project into the lumen of the tune but is separated from the diverticulum by several layers of muscle tissue.

We have thus seen that a decidua scrotina is formed in patches and that a pseudo reflexa in all respects analogous with a decidua reflexa comes also into existence in a tubal pregnancy.

The uterine cast. The question now arises where else may deciduation occur, during a tubal pregnancy. It has been observed in the following positions by various observers. (1) In the opposite tube by Haultain, Kroemer & Whitridge Williams. (2) In the peritoneum of the appendix, Hirschberg who also found large decidua-like cells in the omentum. (3) In the

ovary of the same side by Russell Andrews. I have no evidence to produce of any of these positions but in six out of my ninety five cases, a complete uterine cast was expelled. One of those cases is specially important. Case No.46 was admitted, collapsed and died 10 minutes after admission. At the post-mortem examination there was a well-developed decidua in the uterus coming low down to the cervix. Of the others, two, No.89 and No.94 were expelled at as early a period as the 2nd month and one, No.30, so late as the 5th month. That only 6.3% of cases should show a definite uterine cast cannot be wondered at when one considers that expulsion occurs at a time when the only observer is the patient. But the fact that a tubal pregnancy is usually accompanied by bearing down pains and symptoms of miscarriage taken along with the presence of a complete cast in the case which died at two months, would lead us to believe that a uterine decidua is developed as a rule in tubal gestation.

Conclusion:

Fifth - The fifth and last conclusion which I am able to draw, is one which requires no discussion at length, but which arises naturally from what has already been said. It is, that although the trophoblast by its phagocytic action on the maternal tissues

is the chief exciting cause of rupture, yet the hypertrophy brought about by decidual reaction in the tube plays no unimportant part. We have seen the epithelium of the tube in all stages of atrophy and destruction under its influence, and we have seen the lumen of the tube finally opened into by this cause. It is perhaps a subsidiary point but one which has not, so far as I am aware, been dwelt upon by previous observers.

The Clinical Aspect:

I now proceed to the discussion of some of the clinical aspects of tubal gestation, employing as the basis of my remarks a series of 95 cases of the disease and bringing some of our pathological results to bear on the clinical symptoms peculiar to the condition.

By a casual glance at the clinical histories of a few of the series, it will be seen that a history of several successive attacks of pain is almost invariably present.

In those cases where the gestation occurs at the isthmus, the number of those attacks may be limited to one as in Case 94 which I specially examined and where there is a history of only one very acute seizure with several attacks of bearing down pain during the passage of the membrane. This is characteristic

in the isthmus, its wall being dense and inelastic, peritoneal rupture occurs early and the haemorrhage may be so great as to cause sudden death (Case 46). Those successions of acute pain receive their pathological explanation in the presence of a gestation sac in the musculature of the tube and the first clinical manifestation of its presence is probably produced by a haemorrhage either into the sac itself or into the muscle of the tube wall, that is, either an intra-saccular or an intra-mural rupture. In my specimen the haemorrhage is everywhere confined within the sac wall and this is probably due to the density of the Isthmian musculature. In the ampulla, however, Bonney (Arch. Middlesex Hospital 1906) describes intra-mural rupture as being one of the primary pathological results, giving rise to the first symptoms of pain and distress. It is more frequently met with at the ampulla where the wall of the tube is not so rigid and where a natural plane of cleavage is well defined between the circular and longitudinal coats.

Varieties of Rupture:

An increase in the amount of this primary haemorrhage is then followed by rupture either into the lumen of the tube or into the peritoneal cavity or into both simultaneously. The usual course, however, will be for this to occur in two successive stages,

viz. first into the lumen and then from a sudden accession of haemorrhage into the peritoneal cavity. Leakage will at the same time probably occur through the ostium if still unsealed and through the isthmus into the uterus. These pathological changes would be represented clinically by at least two separate attacks of pain, bringing the total up to three.

Tubal abortion:

If, however, primary rupture does not occur into the peritoneum a different series of results will follow and will depend on whether the ostium is closed or not. If the ostium has remained unsealed a constant leakage will occur and even the whole products of gestation may be extruded into the peritoneal cavity. On the other hand, the ostium being sealed, a gradual thinning of its walls may take place until finally only mucous membrane separates the mole from the peritoneal cavity. Rupture then occurs close to the ostium giving rise to the para-tubal haematocele described by Handley. How far this series of phenomena is worthy of the name of abortion is not settled. In the cases I have seen, the tube wall was so thinned and destroyed that muscular action must have been very much in abeyance and I am inclined to believe that the expulsion of the ovum is brought about chiefly by the "vis-a-tergo" of haemorrhage, and that the

musculature of the tube assumes a very passive rôle throughout. Actual hypertrophy of muscle in a pregnant tube I have never observed.

The Origin of the Brown Coloured Vaginal Loss:

The leakage, on the other hand, from the isthmus into the uterus gives rise to the typical brownish coloured loss so very characteristic of tubal gestation. There is the usual amenorrhoea, the attack of hypogastric pain followed immediately or within three or four days by a dark coloured loss, occasionally varied by a reddish variety. This altered blood seems to come undoubtedly from the affected tube while the alternating recent blood probably arises in the uterus itself, due to separation of portions of decidua. In the large majority of the 95 cases the uterus was enlarged and thickened while the endometrium must have shared in the excessive vascularity.

Peritoneal Rupture:

Of the three stages in the early history of tubal rupture that occurring into the peritoneum is always the most marked. It is the most painful stage and is associated with collapse, sickness and vomiting. If accompanied by haemorrhage it may be rapidly fatal. I will, then, proceed to show in a few typical cases how the clinical symptoms may be more or less closely

correlated with actual pathology found on operation.

Correlation of Pathology with Clinical Symptoms:

Case 77 may be taken as an example: a case of intra-ligamentous extension with rupture into the peritoneum. A definite history of four successive attacks could be obtained. On June 9th period was due. June 16th, attack of very severe pain which would correspond to a large intra-mural haemorrhage or haemorrhage into the gestation sac. June 19th, a second attack of pain with vaginal loss which would correspond to rupture into the tube lumen. June 22nd, a third attack of pain with loss corresponding to rupture into the broad ligament. June 30th, a fourth attack of pain representing rupture into the peritoneal cavity.

Again, Case 79. No history of amenorrhoea apart from the puerperal amenorrhoea, following the birth of a child three months previously, then a history of three attacks of pain. On operation a ruptured tube was found. The course could be thus interpreted. First attack associated with intra mural rupture or rupture into the gestation sac. Second attack would correspond to rupture into the tube lumen. Third attack with rupture into the peritoneum.

Case 70: A case of unruptured tubal gestation. Here the history speaks definitely to only two attacks of pain. August, first week, a sudden pain with

slight loss corresponding to intra-mural haemorrhage. Then later a flooding with great pain which in all likelihood referred to rupture into the tube lumen.

Again, Case 62: A case of extrusion through the ostium with three successive attacks of pain. Well till a month ago when a sudden pain doubled her up - an intra-mural haemorrhage. A fortnight later an attack of the same pain which represents extrusion into the tube lumen and a week ago a third attack occurred simultaneously with a tubal abortion.

These cases may be taken as typical and they show that a carefully examined clinical history may be of great help in forming some conclusion as to the state of affairs in the pelvis. The number of successive attacks would seem to be an indication, at any rate as to whether rupture had occurred or not. These features, however, possess a different significance in different cases and must be judged simultaneously with the physical conditions present. If, for example, a pelvic haematocele of some size and duration be palpated, the earlier attacks of pain which immediately succeeded the extension of the gestation will be probably forgotten by the patient in view of the later attacks accompanying the extension of the haematocele. In case 95, for example, the attacks mentioned by the patient represent the formation of a secondary haematocele superimposed on the primary blood sac. The

earlier history was entirely unrepresented. Again, where a foetus is palpated floating in the peritoneal cavity those successions of pain have quite a different significance. This occurred in Case 80. Patient had been one month amenorrhoeic when a severe attack of pain occurred. This probably represented a rupture from the tube into the broad ligament. The second attack of pain occurred in April 1906 when rupture probably took place into the peritoneal cavity. Then a false labour occurred. It will be seen that the minutiae of symptomatology were lost in the light of those larger and more severe attacks. But it will be found that careful inquiry into the actual number of attacks of abdominal pain, combined with a physical examination, will give a fair picture of the actual state of the tube if interpreted in the manner just indicated.

Coming to a closer analysis of the series, we find that out of the 95 cases, 24.2% were primiparae while 75.8% were multiparae, a proportion of 1 to 4 approximately. As to age incidence I have divided the cases under four headings. They are :-

Under 20	..... No Cases.	
Between 20 and 30	..... 32 Cases.	33%
Between 30 and 40	..... 58 Cases.	61%
Over 40	..... 5 Cases.	About 5%.

The heaviest incidence is thus at the ages between 20 and 40 and of these the heaviest is between 30 and 40. The youngest was (Case 16) aged 23 with no history of any previous illness. One of the oldest (Case 32) aged 40 years, is noteworthy on account of 15 years sterility while another case (No.45) aged 42, had a history of 18 years fertile married life, having borne 7 children normally. The eighth pregnancy was an extra-uterine. Again, case 87, is that of a multipara who had had 18 pregnancies, 13 at full term, 4 premature labours, 1 miscarriage at 5 months while the 19th pregnancy was an extra-uterine. The latitude of incidence is thus very wide. It is four times as common in multiparae as in primiparae and twice as frequent between the 30 - 40 period as between the 20 - 30 period. A long period of sterility is by no means uncommon. Out of the 95 cases 27 had a history of sterility of from 5 to 15 years. This is 28.4% of cases and would show that some indirect influence is acting in such a way as to predispose the sterile woman to this complication. These cases include those women who at one time had borne children but had remained secondarily sterile for that length of time. This secondary sterility may have had an underlying basis of chronic salpingitis otherwise latent.

Out of the 95 cases, three alone were not operated upon. The remaining 92 had either vaginal section or coeliotomy performed. Those cases which did not receive the value of operation were:-

First: Case 47. She was presumably four months advanced in pregnancy. The condition was mistaken for a retroverted gravid uterus and an unsuccessful attempt was made to reduce it. Her temperature rose the same evening to 104°F. and the patient who had been previously in an exhausted condition succumbed the following day. The rectum was found to be soft and necrotic and the secondary gestation sac was found to be on the point of eroding into the bowel. Death was due to general peritonitis.

Second: Case 46: Was admitted in a collapsed condition and died before operation could be performed. It will be referred to below.

Third: Case 69: Patient refused operation and as the pelvic tumour seemed to be diminishing she was discharged.

Out of the remaining 92 cases, two were operated on through the posterior fornix. In case 20 this route was adopted owing to a previous coeliotomy having been performed and with the object of avoiding any possible adhesions. The contents of the sac were

evacuated through the fornix and the cavity packed with gauze. Recovery was uninterrupted. Again, in case 71 a right salpingo-oophorectomy was performed through the posterior fornix. An encysted haematocele was found and cleared out. Recovery was delayed by a foetid discharge but was eventually good. The remaining 90 cases had coeliotomy performed although in two cases the posterior fornix was primarily opened and coeliotomy performed immediately after. In case 62 it was found impossible to deal with the condition through the post fornix and resort was had to the abdominal route. Also in case 74 although an attempt was made to deal with the condition vaginally, it had to be given up. Both broad ligaments were found distended with blood and the condition could only be relieved by having recourse to coeliotomy. Recovery was here delayed by suppuration. There are thus brought out two strong arguments in favour of coeliotomy over vaginal section.

First: The uncertainty of being able to deal completely with the condition by the vaginal route.

Second: The much greater risk of septic contamination with greater delay in recovery, when the latter route is adopted.

Out of the 95 cases of tubal gestation admitted into Chelsea Hospital between the years 1888 and 1907 there were seven deaths. Two of them have been al-

ready referred to, viz. those in which no operation was performed. They were, Case 47, where death followed General Peritonitis, set up by erosion into large intestine. It illustrates one of common conditions which may be mistaken for extra-uterine gest. or vice-versa, viz. a retroverted gravid uterus. The other case unoperated on was case 46 which died 10 minutes after admission. A post mortem examination revealed an abdomen full of blood with a ruptured tubal mole in the isthmus. The left tube and ovary were infantile. Thus out of three cases unoperated on, two died - a strikingly high mortality and sufficient to prove the value of operative procedure immediately the condition is diagnosed.

There remain five deaths out of 92 cases operated on, a mortality of 5.4%. These cases were:-

1st. Case No.6:

A case of pelvic haematocele due to ruptured tubal gestation. The disease was complicated by chronic Bright's Disease and the heart was in a very feeble condition. The local condition, however, rendered operation necessary and death was due to secondary cardiac failure.

2nd. Case No.13:

Patient was admitted unconscious with an acute abdomen. At the operation an extensive haemo-

peritoneum was discovered, due to a ruptured tubal pregnancy. The patient never regained consciousness, dying from haemorrhage and shock.

3rd. Case No.41.

Was admitted with a history of about five months amenorrhoea and a pelvic haematocele was discovered to be foul-smelling and to involve bowel. A faecal fistula developed and death was due to general peritonitis.

4th. Case No.48.

A case of ruptured tubal pregnancy which had recovered from operation so far as to be in the ward several days after, when she suddenly died from pulmonary embolism. At the autopsy, both lungs contained portions of collapse typical of embolism.

5th. Case No.49.

A case in which operation was delayed for some time for the purpose of observation. She was an advanced case of tubal rupture and haematocele. After operation she died of a combination of shock and peritonitis within half an hour.

Causes of Death in Tubal Gestation:

On tabulating these cases we get:-

General peritonitis with shock .... 3 cases.
Acute Haemorrhage ..... 2 cases.
Chronic Nephritis with Ascites .....1 case.
Pulmonary Embolism ..... 1 case.

Peritonitis:

One of the cases included under the first group was operated on in 1888, shortly after Lawson Tait had performed his first section for the condition at a time when the abdominal toilet was not performed with our modern up-to-date precautions. Although acute haemorrhage now undoubtedly takes first rank as a cause of mortality, yet the first group of cases is of value in showing that in advanced cases where intestines are included in the secondary gestation sac the great danger is contamination of the peritoneum. Indeed, the problem of how to deal with an extensive area of necrotic intestine is still a difficult one. Fortunately cases are now dealt with earlier in the course of the disease and a large resection of gut now rarely required. Since the year 1902 no such complication has occurred in Chelsea Hospital for Women, the case which died in that year being auto-infected before admission. The other causes of morbidity, haemorrhage and embolism must unfortunately always remain a difficulty. With them the surgeon cannot, at present, cope. The safety of the

haemorrhaging patient depends more on her own celerity in seeking advice than on the dexterity of the surgeon.

Embolism:

In cases of embolism there are, I think, two factors. One of those, I think, is anaemia. Embolism occurs more frequently in patients who have lost blood copiously such as from an ulcerating fibroid or have suffered from some auto-destruction of blood corpuscles. The blood is rendered more easily coagulable and where I have feared the onset of embolism I have administered citric acid copiously with some advantage. The other factor is one of slight sepsis. I have noticed that the charts of patients who have died of embolism show a slight rise of temperature at some stage in convalescence, usually within a fortnight after operation. Now it is remarkable that those cases of tubal pregnancy which do show a slight rise of temperature 100°F. to 101°F. usually exhibit either free blood in the peritoneal cavity or blood encysted in the form of a pelvic haematocele. This blood, I believe, if allowed to remain for any length of time becomes contaminated and for this reason early operation is strongly indicated. Cases 41, 47 and 49 are examples in point. In case 41 the contents of the cyst were foul-smelling and the patient died from general peritonitis.

Dudgeon & Sargent recently examined 20 cases of intra-peritoneal haemorrhage, 17 of them being due to extra-uterine pregnancy and found a staphylococcus albus present in every case without exception. This organism they consider a normal inhabitant of the peritoneum but of slight pathogenic properties. If, however, it be associated with bacillus coli it may bring about a lethal termination. Case 95 in the series is also an example of contamination of a pelvic haematocele. The blood had been so altered as to resemble a pelvic abscess with the usual foetid musty odour. No organism, however, could be got in film preparations. The patient afterwards ran a temperature of 101°F. - 102°F. and developed an abdominal sinus. Earlier operation would thus have avoided these complications.

Extraneous Causes of Death:

Lastly chronic nephritis with ascites represents a purely extraneous complication which has no definite bearing on the subject in hand. The lesson, however, to be drawn from those fatal cases seems to be that the presence of a haemorrhage free or encysted by its faculty of becoming contaminated is a decided source of danger to the patient by giving rise to general peritonitis or even embolism. Immediate operation

is thus the proper treatment.

ANALYSIS OF SYMPTOMS:

I now proceed to an analysis of the clinical symptoms of tubal gestation as shown in the series of 95 cases and to contrast them with those of tubo-ovarian abscess.

I have tabulated the commonest symptoms thus:-

(1) Pelvic pain with brownish vaginal loss occurred in 98% of cases.

(2) Amenorrhoea varying from 2 days to 5 months in 43% of cases.

(3) Errors of micturition varying from acute retention to loss of control in 28% of cases.

(4) Passage of a uterine cast or portions of decidua in 7.4% of cases.

Pelvic Pain:

Pelvic pain and vaginal loss are thus the most uniformly present. The location and severity of this pain may vary. The commonest type is a sharp cutting pain located in the pelvis or lower abdomen as severe as to double the patient up. Or it may be described as a bearing down pain shooting from the abdomen down the thighs and legs. It is often located in the affected side, one or other iliac fossa. In one form or another pain is almost invariably present and shows usually an acute onset.

Vaginal Loss:

Vaginal loss, varying from a brownish coloured discharge to that of a bright red, is also almost uniform. The patient may flood; she may lose as much as at a labour or she may merely continue to ooze blood. She may describe her loss as consisting of clots and may have detected membranous material being passed. One of the series described a uterine cast perfectly as "like a purse with a neck to it".

Amenorrhoea:

Amenorrhoea, on the other hand, we find is not so constantly present as one might have expected. It occurs definitely in about 43% of cases. This figure includes those cases where menstruation was delayed only for a few days. The first symptom which warns the patient that something is wrong may be on the contrary an excessive loss occurring at her expected time. The previous period may have been scanty, lasting only two days, where she formerly used to menstruate five days. Or again the period may have appeared quite regularly but to her astonishment continues four or five days beyond her proper time, succeeded perhaps by an attack of pain. But a definite period of distinct amenorrhoea must not be looked for in every case. The diagnosis, it is true, never seems so certain without it, and it is here where the possibility of

tubo-ovarian abscess renders the position more difficult because amenorrhoea is also one of the commonest symptoms of that condition.

Micturition, etc.

Difficulties of micturition again are very common - usually frequency and pain. It may occasionally amount to loss of control or even complete retention. Associated conditions such as dyspareunia and constipation are often present. The latter condition may be accompanied by severe pain and passage of blood.

A succession of attacks of pain is also usually to be elicited from the one severe attack of isthmic rupture to a succession of five or six attacks in the well formed pelvic haematocele. This point I have already dwelt upon in attempting to correlate tubal pathology with its clinical symptoms. 45% of the series showed a succession of such attacks from two upwards. This, taken in conjunction with the size of the pelvic tumour, may often lead to a correct pathological diagnosis.

Physical Signs:

Into the physical signs of tubal gestation I do not propose to enter at length. Sufficient is it to say that the commonest result is to be able to

palpate in one or other fornix, a tumour semi-solid to the touch which may or may not emerge above the pelvic brim. The uterus itself will usually be found enlarged and may be displaced to one or other side. It may be drawn upwards so far that the cervix is almost out of reach of the examining finger. The great point will be to accurately delineate the uterus as existing apart from the swelling. One or other of the fornices may be totally obliterated, the posterior fornix perhaps most frequently by the pressure in an impacted pelvis. In advanced cases, on the other hand, one may be able to palpate the foetus or as I actually was able to, in one case, to see the outlines of the foetus through the abdominal parietes (Case 80). Pulsating vessels may be felt in the fornices and the examining finger may be found smeared with the typical reddish brown loss. But in the end, even when he considers his diagnosis complete, the examiner may find that when the abdomen comes to be opened he has missed the most salient feature of the case, viz. a couple of pints of free blood in the peritoneum. The abdomen may have been hyper-tympanitic all over, even the resonance in the flanks being unimpaired and yet free blood is present in a diffuse form. I have been deceived in two cases by this and consider it due to a general distension of bowel con-

cealing the primary condition.

Tubo-ovarian abscesses - their symptoms:

Or again, the examiner may find to his surprise that what he had diagnosed an extra uterine gestation turns out in reality a

Tubo Ovarian Abscess.

On more than one occasion I have been so deceived and on looking into the matter, have found the two conditions as similar, both on physical grounds and on that of symptoms, that I make no apology for dwelling on their comparison. Cullingworth in the Bradshaw Lecture 1902, was among the first to notice this remarkable resemblance. He there refers to two cases of tubo-ovarian abscess which simulated tubal pregnancy. In both he says the clinical history and physical signs were equally compatible with the diagnosis of inflamed appendages or with ruptured tubal gestation. The clinical history in one case was that of pelvic pain followed by irregular haemorrhage. In the second case, the patient had two months amenorrhoea which she thought was due to pregnancy and then lost blood for two days per vaginam. Abdominal section revealed an inflamed and suppurating tube on each side and each tube was in communication with the interior of a suppurating ovarian cyst. Again, Haultain (JL. Ob. & Gyn. 1906) mentions a similar case where there was a

constantly recurring vaginal haemorrhage which had lasted for three months after a menstrual period delayed a few days. There was a history of persistent pain in the left side with severe exacerbations. He considered it to be a tubal mole but found on opening the abdomen an ovarian abscess, with salpingitis.

Tubal Ovarian Abscesses - An analysis of 15 cases:

Out of a large number of cases of tubo-ovarian abscess recorded in the Hospital Statistics, I have selected 15 cases, some of which I had under my care. Analysis of those brings out the following results:

First: Age Incidence:

Between 20 and 30 ..... 40.3%

Between 30 and 40 ..... 53.3%

Above 40 ..... About 6%.

Contrasted with the corresponding figures for extra uterine gestation this shows a higher incidence on the ages between 20 and 30 and a corresponding reduction on the 30 - 40 decade. Above 40 the incidence is similar.

Second: Amenorrhoea:

Amenorrhoea was present in 33% of cases. This is a reduction of 10% on the corresponding figure for extra uterine gestation, but it is a significant figure in this relation.

Third:

Pelvic or abdominal pain was present in 93% of cases and a reddish vaginal loss in 83%. This vaginal loss is represented in the actual cases by menstrual irregularities, excessive losses continuing for days after a normal period would have ceased - sometimes by the passage of clots and sometimes by floodings of considerable amount. Pelvic pain comes on in exacerbations and in several successive attacks and sometimes is bearing down in character. This completes a very similar clinical picture, the one outstanding difference being perhaps the more frequent presence of a history of a yellowish vaginal discharge in tubo-ovarian abscess. It is present in 20% of cases of the latter condition and only occasionally in extra uterine gestation. How can we explain this similarity ? On making a closer examination of cases of inflamed tubes we find that the resulting symptoms are different, according as the ovary is involved or not. Where the ovary has escaped infection and the inflammatory action is confined to the tube, the symptoms presenting themselves are dysmenorrhoea and pelvic pain. But where the ovary has been invaded and a recent corpus luteum infected we get in addition irregularities in menstruation, viz. either delayed menstruation followed by a sharp attack of pelvic pain and excessive

vaginal loss or a premature onset of menstruation with pelvic pain and excessive loss. Now these facts seem to point conclusively to the influence of the corpus luteum as a regulating mechanism over menstruation. L. Fraenkel has enunciated the following conclusions regarding this organ which he has drawn from experiments on animals and also from observations in cases of operation:

(1) The corpus luteum is a gland with an internal secretion.

(2) The corpus luteum carries cyclic nutritive impulses to the uterus affecting the endometrium.

(3) It effects the adhesion of the ovum and when failing to do so it excites menstrual secretion.

Fraenkel states that his observations prove that the Graafian follicle ruptures a fortnight before the uterine flow and that the corpus luteum which results determines the next menstruation. This, however, has not been proved either experimentally or clinically but it is a useful theory and one with which my clinical observations seem to fit in. The ruptured Graafian follicle must be a "locus resistentiae minoris" and if the tube be already septic, must afford a nidus for whatever germs are at hand. They enter the follicle and destroy the material basis for a corpus luteum. Its internal secretion is thus either perverted or totally destroyed and with this results the

menstrual irregularities I have just described, viz. either delay or premature onset, according as the lutein material is in an early or late stage of growth when infected. More definite knowledge of the function of these lutein cells is required before this can be called more than a speculation but it would appear to afford a rational explanation of the well-known menstrual irregularities which are associated with the presence of a tubo-ovarian abscess.

Other Cases of Interest:

I have now a few words to add as to some of the cases which present points of interest and to conclude my paper by some observations on aetiology.

Recurring Tubal Gestation:

Case 60 is of interest. She returned almost exactly a year after with a similar condition in the opposite tube. A case of recurring extra-uterine gestation.

Case 67 is probably a case of bi-lateral extra uterine gestation. The left tube curves round a swelling the size of a hen's egg - an unruptured tubal pregnancy while the right tube shows a large ragged sac filled with blood clot containing an embryo 1" long.

Case 68. The tubal placenta and amniotic sac were so beautifully intact that it has been drawn and exhibited. Drawing No.16.

Gestation almost to Full Term:

In three cases gestation had continued beyond seven months, and two of them were secondarily abdominal. The greater part of gestation had continued in the broad ligament in all of them. Case 43, the ovum had burrowed from the broad ligament into the meso rectum. In cases 44 and 80 rupture had occurred into the peritoneum and in each case the foetus lay free in the abdominal cavity - surrounded by amnion from which liquor had totally escaped. In case 80 the foetus presented a peculiar appearance. A spurious labour had occurred driving the foetal head into the right half of the pouch of Douglas with the result that the right half of the child's face was absolutely flattened. The loins and axillae were stained purple by prolonged maceration in liquor amnii.

Value of a Blood Count in Tubal Gestation:

Case 95 is that of a pelvic haematocele which had become infected although the organism primarily present could not be ascertained. Film preparations and culture growths were negative. Before operation a leucocyte count showed an increase to 12,000 with a high percentage of eosinophils and hyalines 6%. On

this evidence I diagnosed abscess formation. The value of a blood count in the differentiation of haematocele from tubo-ovarian abscess is very great. Where clinical evidence is not sufficient, a count will usually afford some help. I have found that a count of 10,000 or upwards with a relative increase in eosinophiles and hyalines is a decided indication in favour of pus in the pelvis. Cases of pure haematocele will give a count of anything up to 10,000 but not frequently anything above that. My working basis has been that a count above 10,000 with an atypical relative count, especially an increase in eosinophiles and hyalines indicates the presence of pus. The remaining points of interest I have placed in tabular form . Here tubal pregnancy followed the various conditions mentioned or was complicated by their presence.

Conditions which complicated tubal pregnancy:

(1) Peritonitis: 3 cases: Nos. 1- 28- 69.

(2) Chronic Nephritis: 1 case: No.6.

(3) Primary Dysmenorrhoea: 8 cases: Nos.7, 19, 9, 15, 17, 34, 57, 72.

(4) Cystic Ovaries, the same or opposite side; 6 cases: Nos.8, 4, 50, 60, 94, 18.

(5) Retained Secundines with curettage: 3 cases: Nos. 10, 11, 68.

(6) Uterine Displacements: 4 cases: Nos.19, 18, 39, 35.

(7) Endometritis in 4 cases: Nos.23, 26, 57, 75.

(8) Yellow Vaginal Discharge: 3 cases: Nos.36, 55, 63.

(9) Puerperal Fever: 1 case: No.85.

(10) Infections of the Tube: 3 cases: case 68 coccal, cases 55 & 63 resembling tubercle.

(11) Infantile Tube & Ovary: Case 46.

In connection with this tabulated list I shall discuss the various theories which have been at one time or another supported as to the aetiology of tubal pregnancy. These theories are numerous and as usual where many exist, no one of them is wholly satisfactory.

(1) Salpingitis and Perimetritis: Virchow in 1850 was the first to propose this as an important aetiological factor in tubal gestation. In 1889 Lawson Tait supported him by suggesting desquamative salpingitis as the probable cause. Then Mandl & Sehmet in 1897 found that 24 out of 77 cases had suffered from a previous gonorrhoea. They pointed out that tubal pregnancy was rare in animals but common in women and that inflammatory diseases of the tube had a similar incidence. The commonest inflammatory causes are stated by Gletsch to be :-

Gonococci.

Puerperal Causes.

Tubercle.

In my series, if I include those who had suffered from peritonitis and puerperal fever which may have left some perimetritis behind, there are eight cases which can definitely be included under this heading. Two cases were probably gonococcal while two were probably tubercular. This would bring the aggregate to 8.4% of all the cases. This is relatively small. But if we consider that these cases of secondary sterility we have already mentioned may have at one time suffered from a latent gonorrhoea, we bring the aggregate up to 36% of cases. Thus salpingitis must be considered, if not directly aetiological, yet a very common coincident condition.

(2) Infantile Types of Tube: An infantile type of tube has been held to be a possible cause. I have only evidence of this in one case, No.46, where the opposite tube and ovary were infantile. The condition is, however, a pathological rarity compared to the frequency of tubal gestation.

(3) Puerperal Atrophy: Again, puerperal atrophy of the genital organs has appeared to Duhrrsen as a possible factor. He has found this condition present in those cases where a prolonged succession of gestations in the uterus and where prolonged suckling has exhausted the mother. But out of 400 abdominal

sections at Chelsea Hospital for Women for various causes, I have only observed a condition of atrophy present in one case and that in a woman ten years over the menopause. It is also more than likely that a premature decay if affecting the tube would also simultaneously affect the ovary, causing a premature menopause. Duhrrsen's theory is, therefore, unlikely.

(4) External or Internal Wandering of the Ovum:

External or internal wanderings of the ovum together with other abnormalities of the ovum. Of these I have no evidence. In my series there were present six cases of cystic ovary. In case 94 there was present a lutein cyst of the same side and the ovum may thus have had a pathological bias to begin with. Again, it is not at all inconceivable that an ovum from which the zona pellucida has disappeared and in which the trophoblast has become even slightly developed may be compelled to embed before reaching the uterus. An extension of route from one ovary to the opposite tube might bring about this over-development. That is a pure speculation, however. That external wandering of the ovum does occur, has indeed been proved, both experimentally and clinically, but until an ovum can be studied early in the process of embedding it would be difficult to say how far this

affects tubal gestation.

Diverticula: Finally, I come to a cause of which I can show definite evidence, viz. the presence of diverticula in the tube.

In 1899, Henrotin & Hertzog described a case of tubal gestation in an accessory pavilion, which had no communication with the main lumen of the tube. The first recorded case of diverticular pregnancy which I can find is one by Opitz in 1902. Serial sections were, however, not cut and the drawing made of the specimen would lead one to believe it a mere kink in the tube. Since then, however, evidence has been accumulating.

In 1903 Micholitsch recorded 10 cases of embedding of the ovum in secondary processes of the lumen and found invaginations of mucous membrane in every one of 30 cases he examined. Futh also considers diverticula to be important factors in the causation of tubal pregnancy. They would appear to be more frequently present than had been supposed, but whether they are of developmental origin or due to inflammatory causes, is still an unsettled point. In my specimen the diverticulum exists, with no surrounding evidences of salpingitis.

Briefly stated, the facts of my case are:-

(1) The presence of a diverticulum arising from the isthmus about $\frac{1}{2}$" in length.

(2) The presence of a gestation sac close to the blind extremity of this diverticulum.

(3) The presence of the earliest decidual reaction in the submucosa of this diverticulum with primary rupture into its lumen.

These three facts would lead me to conclude that the cause of this tubal pregnancy was the shutting up of the ovum in this recess. From the absence of other signs of salpingitis I would also infer that in this instance at least the diverticulum was developmental. A drawing will be found on Sheet 16 of the probable position of the gestation sac in the wall of the tube.

Conclusions reached in this paper are:-

(1) In tubal pregnancy the gestation sac is primarily intra-mural.

(2) That a decidua basalis is formed in patches by maternal reaction on the part of the sub-epithelial stroma.

(3) That the walls of the larger capillaries and arteries are so altered by trophoblast that they may become partially auto-thrombosed. Decidua-like cells are, however, not formed in the walls of arteries.

(4) That tubal rupture is brought about (1) by trophoblast, (2) by the pressure of decidual hypertrophy, (3) by the resulting haemorrhage from invasion of veins and capillaries.

(5) That the pathological stages in tubal rupture can be clinically identified in successive attacks of pain in most cases.

(6) That diverticular embedding may be a common cause of tubal pregnancy. Those diverticula are probably developmental.

(7) Various degress of salpingitis, acute and chronic are so frequently present that they may be indirectly aetiological.

(8) That tubo-ovarian abscess is a common condition to mistake for tubal pregnancy and that its symptoms may be caused by diminution and perversion of lutein secretion.

(9) That the abdominal route is superior to the vaginal in dealing with tubal pregnancy.

(10) That early operation is the correct procedure when dealing with a pelvic haematocele. If postponed, the evil results of sepsis may injure the prospects of the patient.

L I T E R A T U R E .

The literature which I have consulted throughout the paper is the following:

Cullingworth. Bradshaw Lecture, 1903.

Arthur Robinson: Hunterian Lecture, 1903.

Playfair's System of Midwifery, Ed.7, 1889.

Russell Andrews in Jl. Ob. & Gyn. 1903.

Ibidine, 1905.

Berkeley & Bonney: Jl. Ob. & Gyn. 1905.

Bonney: Archives Middlesex Hosp. Vol.8, 1906.

Haultain: Jl. Ob. & Gyn. 1906.

Ballantyne & Williams: B. M. J. 1891.

Bland Sutton: Diseases of Tubes and Ovaries.

For many cross references to continental literature I am indebted to many of these authors but chiefly to Russell Andrews who has summarised the literature in Jl. Ob. & Gyn. 1903 and 1905.

Finally, I must acknowledge my indebtedness to the Staff of Chelsea Hospital for Women for placing material at my disposal and specially to Dr Eden, Mr Victor Bonney and Dr Taylor for much guidance during the course of this research.